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STORMWATER LOW IMPACT DEVELOPMENT (LID) POLICIES

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STORM LOW IMPACT DEVELOPMENT (LID) - DESIGN CRITERIA

I. RAIN GARDEN/BIOINFILTRATION

A. General Information

Rain gardens are excavated or otherwise formed depressions in the landscape that provide for storage, treatment, and infiltration of stormwater runoff. Rain gardens can be design to receive runoff from any impervious surface area such as roof, driveway, parking area, road, or sidewalk. The soil in the depression is enhanced to promote infiltration and plant growth.

There are minimum design requirements for rain gardens, but the design can vary depending on the size, shape, location, and site conditions. For example, some rain gardens will have inflow piped in from a roof downspout, while others will receive runoff as sheet flow over a spillway from a parking lot. Since rain garden designs are not as standard as other stormwater facilities, the engineering details in this section are to be used as guidelines and may need site specific modifications.

Under-drains should only be installed when the rain garden is:

- Located near sensitive infrastructure (e.g., unsealed basements) and potential for flooding is likely.
- Used for filtering storm flows from gas stations or other pollutant hotspots (may require an impermeable liner).
- In soils with infiltration rates that are not adequate to meet maximum pool and system dewater rates.

B. Design Guidelines for Rain Gardens

1. Areas to be used for rain gardens must be protected from compaction. Before site work begins, clearly mark and install silt fence around proposed rain garden areas to avoid soil disturbance, siltation and compaction. This area must be protected throughout construction.
2. If an inlet pipe is not used, include concrete spillway from road to inlet of rain garden. Install rock and/or plants to dissipate energy and prevent erosion.
3. Wheel-stop or curb is required at edge of rain garden.
4. Allow 2' (at 2% slope) between sidewalk/curb edge and top of rain garden side slope.
5. An irrigation system must be installed for the first two years after plant installation.
6. COK Maintenance Agreement is required.
7. Rain gardens shall not be installed in sensitive area buffers or on slopes steeper than 20%. Rain gardens proposed on slopes steeper than 15% or within 50' of a steep slope/landslide hazard area must be approved by a geotechnical engineer or engineering geologist.
8. For sites with septic systems, rain gardens must be located down-gradient of the primary and reserve drainfield areas, unless approved by engineer.
9. The rain garden must not create flooding or erosion impacts.
10. Rain garden shall be designed to drain in 24 hours. Water storage volume in cubic feet shall equal 0.25 times the square footage of the impervious surface area served, or sized using Western WA Hydrology Model (WWHM) or other approved continuous runoff model.
11. Infiltration rate of bioretention soil layer shall be 1 inch per hour or greater.

C. General Maintenance Requirements for Rain Gardens

Maintenance Components	Required Inspection Frequency¹	Condition When Maintenance is Required	Action Required
Ponding Area			
Earthen reservoir (berms, weirs, and side slopes)	B, S	Erosion (gullies/rills) greater than 2 inches deep around inlets, outlet, and side slopes	Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control blanket)
	A, S	Settlement greater than 3 in.	Restore to design height
	A, S	Downstream face of berm or embankment wet, seeps or leaks evident	Plug holes. Contact geotechnical engineer ASAP.
	A	Evidence of rodent holes	Eradicate rodents and repair holes
Sediment or debris accumulation	B	Accumulated sediment or debris significantly impacting rain garden infiltration rate or surface storage capacity	Remove excess sediment, bioretention soil, or debris. Identify and control the sediment source.
Inlet via surface flow	A, S	Signs of erosion are visible, soil is exposed, water disrupts soil media	Repair and control erosion sources, replace or reconfigure splash block area.
Inlet via concentrated flow (curb cuts or pipe)	A, S	Sediment, vegetation, or debris partially or fully blocking inlet structure. Pipe is damaged or clogged.	Clear the blockage. Identify source of blockage and take actions to prevent future blockages. Repair or replace pipe if needed.
	A, S	Water disrupts soil media	Reconfigure inlet, add plants/rock
Outlet pipe/structure	A, S	Sediment, vegetation, or debris partially or fully blocking outlet structure. Pipe is damaged or clogged.	Clear the blockage. Identify source of blockage and take actions to prevent future blockages. Repair or replace pipe if needed.
Trash rack	A, S	Trash or other debris present	Remove and dispose trash/debris
	A	Bar screen damaged or missing	Repair or replace bar screen
Check dams and weirs	A, S	Sediment, vegetation, or debris blocking flow control weir or check dam	Clear the blockage
	A	Grade board or top of weir damaged or not level	Restore to level position
Overflow or emergency spillway	A, S	Overflow spillway is 50% plugged with sediment or debris	Remove and dispose sediment/debris
	A, S	Native soil is exposed or other signs of erosion damage	Repair erosion and stabilize surface of spillway
Bioretention soil	As Needed	Water remains in the basin 48 hours or longer after the end of a storm	Check underdrain and remove clogs. If soil is clogged, remove upper 3" of soil and replace with imported bioretention soil. Identify clogging sources and correct.
Mosquitoes	B, S	Standing water remains for 3 days following storms.	Remove standing water, identify cause and take appropriate actions to improve the drainage.

¹Inspection Frequency: **A** = Annually; **B** = Biannually (twice per year); **S**= Additional inspections should be performed after major storm events. For debris/clog related maintenance, inspection should occur in the early fall, after deciduous trees have lost their leaves.

C. General Maintenance Requirements for Rain Gardens (continued)

Vegetation			
Vegetation along cell bottom	Monthly	Poor vegetation growth (less than 75% coverage) or weeds cover more than 15% of area	Remove weeds, replant with native species if needed for plant coverage. Ensure plants receive enough water.
Vegetation along cell upland slope	Monthly	Poor vegetation growth (less than 75% coverage) or weeds cover more than 15% of area	Remove weeds, replant with native species if needed for plant coverage. Ensure plants receive enough water.
Trees and shrubs	A	Large trees and shrubs interfere with operation of the basin or access for maintenance	Prune or remove large trees and shrubs. Replace large trees with other vegetation if necessary.
	A	Standing dead vegetation is present	Remove dead vegetation when covering greater than 10% of basin area. Replace dead vegetation annually or immediately if necessary to control erosion. Determine cause for dead vegetation and correct problem.
Mulch	A	Bare spots (without mulch cover) are present or mulch depth is less than 2 inches	Replenish mulch to cover bare spots and augment to minimum depth of 3 inches.
Weeds	Monthly (March-September)	Weeds are present. See King County noxious weed list: www.dnr.metrokc.gov/wlr/lands/weeds/laws.htm	Remove weeds. To protect water quality, do not use herbicides or pesticides. Class A & B noxious weeds must be removed, bagged, and disposed of as garbage immediately. Reasonable attempts must be made to remove class C.
Line of sight	A	Vegetation causes visibility or driver safety issues.	Prune or remove if continual safety hazard
Irrigation			
Irrigation system (if any)	Monthly (May-Sept)	Irrigation system is present but not functioning properly	Follow manufacturer's instructions for operation, maintenance, and troubleshooting
Plant Watering	Weekly or as required (May-Sept)	Plant establishment period (2-3 years)	Water weekly during periods of no rain to ensure plant establishment
	As Needed	Longer term period (3+ years)	Water during drought conditions or more often if necessary to maintain plant cover
Other			
Spill Response	As Needed	Release of pollutant into rain garden	Report spill to COK Public Works Department, Storm Division (425) 587-3800. Clean up spill as soon as possible to prevent contamination of stormwater. Replace vegetation if needed.

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PERMEABLE PAVEMENT

A. General Information on Permeable Pavement

Permeable pavement is a structural groundcover that allows natural drainage and migration of water into the earth by permitting water to drain through it and infiltrate into the soil below. There are several different materials available, such as porous concrete, porous asphalt, and pavers. Permeable pavement systems require careful design, construction, and maintenance in order to provide good service life and proper drainage. Manufacturer's recommendations should be strictly followed for proprietary systems.

Permeable pavement can be applied to patios, driveways, sidewalks, parking areas, and roads that are privately owned and maintained. Permeable pavement for sidewalks is allowed in City of Kirkland road right-of-way if approved by the Public Works Director.

Permeable pavement should not be located over cisterns, utility vaults, underground parking, or where there is a high risk of chemical spillage.

B. Design Guidelines for Porous Concrete

1. Limit the amount of construction equipment in areas set aside for porous concrete to avoid over-compaction of the subgrade.
2. Ground water must be at least 3 feet below the aggregate subbase layer.
3. Do not place porous concrete on slopes greater than 10%.
4. Subbase is a minimum of 6 inches of clean, angular drain rock, with less than 2% fines (material passing the #200 sieve) and 5% passing the #8 sieve.
5. Immediately before base aggregate and porous concrete placement, remove any accumulation of fine material from erosion with light equipment and scarify soils to a minimum depth of 6 inches.
6. Porous concrete sidewalks placed in City road right-of-way or on private property shall be a minimum of 4 inches thick.
7. Porous concrete pavement shall be permeable enough to absorb water at a minimum rate of 100 inches per hour immediately after the pavement surface has been wetted continuously for at least 10 minutes. Compliance with this minimum rate shall be checked prior to construction approval of the pavement. Compliance may be checked using a simple bucket test in which 5 gallons of water are poured onto the pavement surface all at one from a 5 gallon bucket. If nothing but a scant amount of water puddles or runs off the surface, then the pavement is considered to meet the minimum rate of absorption. If this test is not conclusive, then a 6 inch ring sealed at the base of the pavement surface shall be used to measure the actual rate of absorption.
8. Porous concrete should capture only direct rainfall; do not direct runoff from impervious surface onto the porous concrete (this increases clogging).
9. If existing soils have low permeability and an infiltration rate of 0.5" per hour or less, provide an under-drain to an approved outlet structure.
10. Protect porous concrete from fines and other sediment during construction by covering with visqueen or similar impervious material.
11. Do not apply paint or other sealant to porous concrete.